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ABSTRACT

The document provides 17 outlines of brief instructional units in mechanics, which are intended for incorporation into an existing program of study in ornamental horticulture at the secondary or postsecondary level. To facilitate the flexible use of the outlines, a grid is presented on which seven occupational areas (such as aboriculture, turfgrass maintenance, and greenhouse production) are matched with the appropriate mechanics unit (such as plumbing, hydraulics, tree tools, and irrigation systems). The units involve safety, simple mechanical skills, and the operation and maintenance, but not repair, of equipment, and cover both fall and spring semester work. The statements within units may be expanded into performance (behavior) objectives, which may then be broken down into task or skill units. (Author/AJ)

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HORTICULTURE MECHANICS

COURSE OUTLINE

Lee P. Grant, Richard F. Stinson, and Harry J. Hoerner

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Horticultural Mechanics Course Outline

The techniques for growing and marketing high quality plants have received emphasis in the development of high school and post-secondary programs in ornamental horticulture. The areas of mechanics, however, have not received the attention justified by their importance in horticultural business operations.

In order to incorporate appropriate mechanics areas into an existing program of study, the instructor should first select the occupational areas shown in the left column in Table 1. The second step is to select those mechanics units (from the 17 given) that are appropriate for the selected occupational areas. It is obvious that in many instances a particular mechanics unit is applicable to a number of occupational areas. The third step is to extract units from the Horticulture Mechanics Course outline presented on pages 3 through 9 and incorporate them at suitable places into an existing program of study.

The units involve safety, simple mechanical skills, and the operation and maintenance of equipment. Most horticultural businesses do not expect employees to repair equipment.

The statements within units may be expanded into performance (behavioral objectives), which may then be broken down into task or skill units.

This publication is besed, in part, on "Identification of Mechanical Competency Groups Needed by Skilled and Semi-Skilled Laborers in Horticultural Occupations," 1971, Lee P. Grant, M.S. Thesis, The Pennsylvania State University.

	Instructional Units in Agricultural Mechanics																
	Shop Orientation and Safety	Tool fitting and Repairing	Plumbing and Water Systems	Construction	Small Engines	Hydraulics	Electricity	Tree tools	Grass Cutting Equipment	Steam Generators and Boilers	Air Compressors and Pneumatic	Arc and Gas Welding	Trucks, and Forklifts	Tractors and Nursery Related Equipment	Trucks, Pick-up	Environmental Controls for Plants	Irrigation and Sprinkling Systems	Spraying and Spreading Equipment
Arboriculture	x				x	x		x					x	x				x
Retail Floriculture													x					
Turfgrass Maintenance	x		x	x	x	x		x	x				x	x			x	x
Landscape Contracting	x	x	x	x	x	x	x	x	x			x	x	x			x	x
Greenhouse Production	x	x	x	x	x	x	x			x			x		x		x	x
Nursery Production	x	x	x	x	x	x	x	x					x	x			x	x
Garden Store Operations	x	x	x	x	x	x	x		x				x	x			x	x

Table I. Units of Instruction in Mechanics Needed by Workers in Ornamental Horticulture

HORTICULTURAL MECHANICS COURSE OUTLINE
Fall Semester

I. Shop Orientation and Safety

A. Purpose and Value of Shop Training
B. General Explanation of Tools and Equipment
C. Possibilities of Employment and Job Opportunities as a Result of Shop Training
D. Rules and Obligations for the Students
   1. Conduct while in shop
   2. Proper dress while in shop
   3. Shop keeping
   4. Shop safety
   5. Storage of tools and equipment

II. Fitting and Repairing Tools

A. Safety in Fitting and Repairing Tools
B. Selecting and Using a Power Grinder
C. Cleaning Tools with Pumice Stone
D. Sharpening Shop Tools -- Axe or hatchet, screw driver tip, cold chisel, twist drill bit, auger bit, shearing tools, and wood turning tool.
E. Sharpening Farm and Garden Tools -- Mower knife, garden hoe, baler knife, grass hook, mower blade, and power saws.
F. Fitting Wood Cutting Saws
G. Fitting Circular Saw Blades
H. Fitting Small Band Saw Blades

III. Plumbing and Water Systems

A. Selecting Equipment and Supplies -- Pipe wrenches, pipe vises, cutters, reamers, stock and die sets, taps, joint compound, and threading and cutting oil.
B. Selecting Pipe -- Kinds of pipes, their uses, sizes, and threads.
C. Selecting Fittings -- Common pipe fittings, valves, and faucets.
D. Measuring Pipe
E. Safety
F. Cutting and Reaming Pipe
G. Connecting Pipe with a Pipe Wrench
H. Threading Pipe
I. Protecting Plumbing from Freezing
J. Repairing a Leaky Faucet or Valve -- Facing valve seat, stopping leakage around the stem, replacing a washer, and replacing washer seats.
K. Repairing Flushing Tanks -- Flushing tank troubles
L. Cleaning Out Traps and Drains
M. Using Cast Iron Soil Pipe -- Cutting soil pipe, making up joints, packing joints, leading the joint, and caulking the lead.
N. Watering -- Automatic timers, mist systems, preparing pipe for mist systems and timers.
O. Fertilizer Diluting Devices -- Principles, use, maintenance.

IV. Construction

A. Sketches, Plans, and Drawing -- Sketches and drawing, mechanical drawing equipment, basic procedures, lettering, views of an object, freehand sketching, reading and interpreting plans, and the bill of materials.
B. Carpentry -- Selecting lumber, seasoning and storing lumber, calculating board and running feet, measuring and marking wood, how to lay out a foundation, wooden steps, decks, screening fences, and identifying the structural parts of a building.
C. Masonry -- Selecting materials, types of mixtures, estimating materials needed, methods of mixing, constructing forms, placing concrete, finishing concrete, curing concrete, coloring concrete, concrete masonry units, preparing mortar, laying masonry blocks, casting patio tiles and downspout splash pads, constructing steps, laying bricks, stone, or tile in walks or patios, dry wall construction.

V. Small Engines

A. Safe Operation of Small Engine Equipment
B. Servicing Small Engines -- Types of small engines.
C. Cleaning Small Engines -- Importance of cleaning the engine, how small engines are cooled, tools needed, cleaning and inspecting crankcase and accessories, cleaning and inspecting the cooling system.
D. Servicing Carburetor Air Cleaner -- Types and how they work, when to service, tools needed, servicing the oil bath, oil bath filter and dry filter types.
E. Servicing Fuel Strainers -- Types, importance, tools needed, servicing the sediment bowl, and screen types.
F. Servicing Crankcase Breathers -- Types, how they work, importance, tools needed.
G. Lubricating Small Engines -- Types, importance, selecting crankcase oil, tools needed, checking and changing the crankcase oil, and storing new and used oil
H. Refueling -- Selecting and mixing fuel, high-octane fuel.
I. Servicing Spark Plugs -- Types, importance, tools needed, servicing and installing.
J. Checking and Adjusting Carburetors -- Principles of operation, types and how they work, tools needed, adjusting the parts of the carburetor.
K. Checking Compression
L. Four-Stroke Cycle and Relation to Engine Operation
M. Starting and Operating Engines -- Preparing to and starting engine, importance of proper operation, adjusting speed and load, stopping the engine, storing the engine, protection from corrosion, moisture and gum deposits, and dirt.
N. Experience in Operating Small Engine Equipment

VI. Hydraulics

A. Basic Principles of a Hydraulic System
B. How Power Is Developed -- Rotary, vane, reciprocating, and centrifugal pumps.
C. How Power Is Transmitted -- Hydraulic lines, gaskets, seals, packing, line fittings, and cylinders.
D. How Power Is Controlled -- Volume control, directional control, and pressure control valves.
E. Importance of Regular Maintenance -- Selection of oils, oil filters, maintenance of hydraulic systems, break-away couplings, hoses, trouble shooting hydraulic systems.
F. Safety

VII. Electricity

A. Electric Current -- Conductors, insulators, circuits, voltage, amperage, electrical power, electric meters, AC, DC, and phases.
B. Splices and Connectors -- Insulation, soldering, and splices
C. Safety Practices in Electrical Work
D. Planning the Wiring System -- Service drop, metering, feeders, panels, service circuits, wire sizes, fuses, and breakers.
E. Calculating Your Needs -- Draw wiring layout for greenhouse, locate power entrance, determine load and size of entrance cable and switch box.
F. Electric Motors -- Selection and care, protection from overloads, lubrication of motors, and cleaning motors.
G. Grounding Electrical Devices
H. Maintaining the Wiring System -- Replacing switches, fuses, and other outlets, and resetting a circuit breaker.
I. Trouble Shooting.

HORTICULTURAL MECHANICS
Spring Semester

I. Shop Orientation and Safety

(Repeat Fall Semester Safety Instruction for new students.)

II. Tree Tools

A. Safety Practices in Tree Work
B. Skills in Operating Tree Tools
C. Equipment Needed -- Power head and earth augers, electric crane with mounting well with ball carrier, spades, scoops, picks, forks, rakes, twine, burlap, planting line, tree support kit, planting tools, and budding and grafting tools.
D. Tree-Climbing Tools -- Rope, safety lock snap, safety saddles, climbing spurs, sectional tree ladder, axe, lightning protection equipment, pruning compound or paint, log splitter, light weight power saw, tree trimmers, hand tool files, plastic mold hard hats, cable, turnbuckles, cable clamps, feeding needles, safety signs, nursery hand truck, and sprayers.
E. Identification, Proper Use, and Care of Hand-Operated Tree Trimming Tools
F. Care and Safe Use of Tree-Climbing Equipment

III. Grass Cutting Equipment

A. Use of Grass-Cutting Equipment -- Golf courses, parks, highways, schools, industrial plants, estates, cemetaries, institutions, government installations, airports, railroads, nurseries, private residences.
B. Types of Mowers -- Riding, large tractor, small tractor, field lawn, and greens mowers.
C. Selecting a Mower -- Mower cutting principles, tractor, chassis, reel, width of cut, cutting mechanism, bed knife, balanced design, drive, clutches, cutting height, grass catcher, transportation wheels, weight, selection based on care and maintenance, selection based on cost.
D. Maintaining Mowers -- Maintaining cutting mechanisms, checking and conditioning the knife, checking and conditioning the guards, maintaining power take off shafts, drive shafts and bearings, safety release mechanisms, V-belts, pulleys, roller chains and sprockets, and gear drives.
E. Safety Practices and Trouble Shooting
F. Experience in Operating Mowers

IV. Steam Generators and Boilers

A. Types of Steam Generators -- Stationary and portable boilers, other.
B. Use of Steam Generators -- Soil pasteurizer.
C. Principles of Operation -- Operation pressure capacity.

D. Maintenance
E. Safety
F. Exercise in Steam-Treating Soil

V. Air Compressors and Pneumatic Powered Equipment

A. Types of Compressors
B. Use of Pneumatic Powered Tools and Compressors
C. Principles of Operation
D. Maintenance and Storage
E. Safety

VI. Arc Welding

A. Selecting Equipment and Supplies -- AC and DC welders, selecting a welder, equipment, and supplies.
B. Electrodes -- Classification of electrodes.
C. Safety Practices -- Installation, safety practices, maintenance
D. Preparing for Arc Welding -- Cleaning metal, selecting proper heat, starting the arc, arc length, angle to hold an electrode, movement and speed, welding positions and joints, controlling distortion of warping and cracking.
E. Welding Exercises -- Running beads in various positions, butt weld in flat and other positions, and types of electrodes for welding cast iron.
F. Cutting and Grooving -- Types of electrodes and heat selection, cutting instructions.
G. Hard Surfacing -- Electrodes, procedure.
H. Carbon Arc Torch -- Torch and supplies, using the torch, suggestions for use.
I. Welding Terms

VII. Gas Welding

A. Selecting Gas Welding Equipment and Supplies
B. Safety Practices
C. Setting Up Equipment
D. Operating a Gas Welding Torch -- Selecting welding tips, preparing for welding, turning off the torch, and cleaning and storing welding tips.
E. General Practices in Welding
F. Fusion Welding without a Rod
G. Welding With a Steel Rod -- Butt welds in flat position, single vs. butt welds in other positions, and fillet welds.
H. Bronze Welding -- Bronze welding in flat and vertical positions.
I. Welding Cast Iron -- Bronze rod and cast iron rod.
J. Hard Surfacing
K. Cutting with Gas -- Starting the oxyacetylene torch, the oxypropane torch, cutting steel, cutting holes in steel, and cutting cast iron.

VIII. Trucks, Pick-up Trucks, and Forklifts

A. Types
B. Safe Use of Trucks
C. Principles of Operation
D. Maintenance
E. Experience Exercises

IX. Agricultural Tractors and Nursery Related Implements

A. Types -- Small and large tractors and bulldozers
B. Use of Tractors
C. Safety
D. Principles of Operation -- Identifying parts of tractor and engine, starting carburetor and diesel types, and making adjustments during warm-up. Hitching to tractor-operated equipment, attaching to drawbar, hitching rear mounted equipment, connecting the power take off, connecting the hydraulic cylinder, hitching to belt-driven equipment. Controlling tractor movement, type of tractor transmission, starting a tractor, operating a moving tractor, stopping a tractor. Operating tractor under field conditions, adjustments before field work, matching gear selection with engine speed and load, handling overloads when stopping tractor, tire slippage, pulling out of a mud hole or ditch. Doing routine operation jobs, mounting and dismounting, low tire pressure, checking temperature, oil pressure, and ammeter gauges. Operating tractor under highway conditions, providing safety warning devices, speed, right of way, slowing or stopping at road speeds, and towing a farm tractor. Operating under field conditions.
E. Maintenance -- When providing the regular ten hour service, check these: air cleaner, crankcase oil level, cooling system, grease job, removing impurities from diesel fuel, safety checking of clothing, and miscellaneous items. Refueling with liquid fuels and LP gas.

X. Mechanically Controlling Artificial Plant Environments

A. Reasons for Controlling the Plant Environments
B. Types of Controls -- Thermostat, interval timer, humidistat, and relay switches.
C. Placing Controls in the Greenhouse -- Electrical wiring and water lines.
D. Principles of Operation -- Setting the time on and time off mechanism.
E. Monitoring Control Equipment
F. Safety
G. Maintenance and Trouble Shooting

XI. Spraying and Spreading Equipment

A. Types of Sprayers -- Tractor mount and hand operation types, truck-type sprayers.

B. Safe Use of Sprayers and Spreaders -- Trees, shrubs, lawns, and horticultural crops.
C. Mixtures for Sprayers and Spreaders -- Dusts, liquids, poisonous and non-toxic sprays and dusts, compatibility of materials.
D. Parts of Sprayers and Spreaders
E. Principles of Operation -- Source of power, hoses.
F. Operation Experience
G. Maintenance

XII. Irrigation and Sprinkling Systems

A. Water and Soil Conservation -- Water and soil conservation, irrigated land problems, need for proper planning.
B. Sprinkler Systems -- Pipe and canal systems, sprinkler systems, components, sprinklers, nozzles, pipes or tubing, regulators and gauges, sprinkler laterals, main pipelines, pumping equipment, power, systems control equipment, inlet systems, screens, and debris removal.
C. Planning Sprinkler Systems -- Topography, types of soils, water supply, climate, power, field operations, steps in designing sprinkler systems and adjustment of the design, outdoor and greenhouse installations.
D. Soil and Water Relations -- Soil origin and types, differences in humid type soils, water movement in soils, water intake rate in soils, root zone absorption, and irrigation guides.
E. Plant and Irrigation Water Requirements -- Factors affecting plant water requirements, irrigation requirements, determination of sprinkler irrigation system capacity, scheduling irrigation, and irrigation of crops.
F. Irrigation Water Supply -- Water supply from existing sources, utilization of drainage waters, irrigation well development, water quality, water measurement.
G. Sprinkler Pattern -- Sprinkler performance, spacing and selection, classification of sprinklers and their use.
H. Hydraulics of Sprinkler Systems -- Hydraulic principles, hydraulic losses, flow of water in pipes, and main line design.
I. Safe Installation -- Installation survey, pump installation, types of pumps, centrifugal, turbine, pumps powered with internal combustion engines, power take-off pumps, electric motor driven pumps, installation of pipe, installing sprinklers, and field instruction before starting systems.
J. Safe Operation and Maintenance -- When to irrigate, starting the system, controls, operating and maintenance instructions, off-season care, protection from wind, frost, and ice, air conditioning irrigation system, evaluating system, and safety.
K. Economics of Sprinkler Systems -- Equipment and installation costs, annual fixed cost, and annual operation and maintenance costs.